ence depend on the number and the distribution of these abnormal ions as a function of their rate of damping.

It is further shown that only a few constants need be determined in von Schweidler's equations to represent the observations with a good degree of accuracy. The remaining theories do not seem to be adequate to represent the present observations.

FISHERIES.—*Notes on the breeding season and young of Polyodon spathula.* Wm. F. Allen, Institute of Anatomy of the University of Minnesota.

Since the appearance of Mr. Allis's recent papers in the Anatomischer Anzeiger on the "Pseudobranchial and carotid arteries of *Polyodon*" in which he made use of a specimen 130 mm. (5.5 inches) long, I have received several letters of inquiry as to when and where this material was obtained.

It is a well-known fact that nothing is known concerning the early development of *Polyodon*, and very few specimens under 6 inches in length have been obtained.

In 1904, when employed by Mr. Allis, I was sent to the Mississippi River for the purpose of obtaining all of the Ganoid material possible. After considering various localities on the Mississippi River system, the junction of the Ohio with the Mississippi, at Cairo, was selected as probably the most favorable place for obtaining this material.

For an entire year the bars of these rivers were seined at all times of the day and night; also the adjacent overflow lakes, sloughs, and small streams were seined at regular intervals thruout the year, and during the early spring a number of adults were obtained from hoop-nets placed in the channel on the Missouri side of the Mississippi, with the hope of obtaining sexually mature individuals whose eggs could be fertilized and the embryos reared.

So far as early embryonic material was concerned my results were a failure, but a great many specimens from 6 to 12 inches long were obtained, and about 25, varying in length from 4 to 6 inches were secured. Considerable data were obtained concerning the habits that may be of value in future search for this material.

Spawning Season.—In this locality the spawning of this species occurs during the month of March, mainly from the first to the middle of the month. I have never seen sexually mature *Polyodon* weighing less than 15 or 20 pounds and fish of this size are rarely, if ever, taken by seining the sand and mud bars of the rivers; they can, however, be obtained from the deep channel on the Missouri side of the Mississippi, from Bird Point south, by the use of hoop-nets. Floating ice prevented this mode of fishing for the first week of March, 1904, but during the second week, three mature females and several spent females were taken from these nets, but no males. One of these females was tied out from a fish wharf by a stout string attached to its tail, and the other two were placed in a fish cage anchored to the wharf, with the hope of keeping all three alive until a mature male could be secured, but with the result that the one tied out with a string was stolen and the two in the fish cage lived but four or five days, dying doubtless from injuries received in vain attempts to escape. Upon examining the eggs they appeared mature, were black in color, and very closely resembled the eggs of *Acipenser* and *Lepisosteus*. During the third week in March a single mature male was obtained along with several spent females. I am unable to account for the scarcity of males during the breeding season.

From this time on most vigorous efforts were made to secure the young of *Polyodon* by seining the small streams, sloughs, overflow lakes, and the sand and mud bars of the two rivers with a fine meshed seine, but not until July first were any located, when some 25 specimens of from 4 to 6 inches in length were caught from Minor Slough. This slough is located on the Kentucky side, at the junction of the Ohio with the Mississippi. It had been seined numerous times before this; in fact, the very day before, but always with negative results. The previous day (June 30) marked a high water stage of the rivers, and on July first the rivers were beginning to recede rapidly, so that there was a strong current in the outlet of the slough. The small *Polyodon* obtained doubtless migrated from the river during the previous night or early morning, when the water in the outlet could have

been almost at a standstill or a rather strong current. There is no ground whatever for believing that these little *Polyodon* were hatched and reared in Minor Slough.

While this seining was being done a violent thunder storm was in progress so that little time was spent in examination of these most interesting specimens; they were immediately thrown into a fixing fluid. It was noted, however, that their bill or paddle constituted about one-half of their total length, and that their bodies were almost transparent.

Notwithstanding that this slough and other overflow lakes and small tributary streams were afterward frequently seined with a fine-meshed seine, and the river bars were seined with both fine- and coarse-meshed seines, during both day and night, no other young *Polyodon* were found until late in August or early September, when a large number were obtained thru seining, at night or early morning, the mud and sand bars of the Ohio River opposite Cairo on the Kentucky side. Singular to say, they were never obtained in this manner during the day time. Apparently they never leave the channel except at night to feed in the mud and sand bars. These small fish were all obtained by the use of a very long coarse-meshed seine. It is possible that if a sufficiently long fine-meshed seine could have been operated on the river bars at night, or dragged on the bottom of the channel during the day, still younger stages would have been obtained.

My experience with *Polyodon* leads me to believe that it is primarily a deep-channel fish, that the eggs are laid and the young are reared in the deep channel rather than in the shallow water of the river, or in overflow lakes, or in small tributary streams; that the young do not leave the main channel to feed in the mud bars of the river or the sloughs until they have attained a length of 3 or 4 inches. About Cairo, Illinois the spawning season occurs during the month of March, and only specimens from 15 to 20 pounds and up are sexually mature. Fish of this size are rarely, if ever, taken in seining the river bars, but they can be had in small numbers from fishermen operating hoop-nets in the Missouri channel of the Mississippi south of Bird's Point.